temperature regulators and air conditioning. The sections dealing with the amount of heat required for warming and with the heat given off from radiating surfaces are of special interest. It must, of course, be understood that the efficient warming of a large building is a matter that is not susceptible of absolute mathematical calculation, and a great deal of the measure of success attained lies in the manner in which the warming and ventilating appliances are handled by those in charge. The volume before us has proved in the past to be a useful guide to architects and others responsible for providing the arrangements, and with the information which it now contains will no doubt prove equally useful in the future.

Structural Steel Drafting and Elementary Design. By C. D. Conklin, Jr. Pp. vii + 154. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1915.) Price 10*s.* 6*d.* net.

THE author's object in compiling this book has been to provide a treatise dealing adequately with the preparation of shop detail drawings of structural steel work. Such a book is required no less in Great Britain than in the United States. In both countries there are several very good books dealing with the design of structural steel work. Some of these contain excellent expositions of the more theoretical work, but they do not meet the requirements of the practical draughtsman, and speaking generally, leave the reader with a very small knowledge of structural details. The book before us gives a clear and minute description of the methods adopted in some leading American drawing offices, and includes designs of riveted connections, beams and columns, steel roofs, a deck plate girder railway bridge, a through girder bridge, etc. Fully-dimensioned working drawings are given as well as the simpler calculations required in the design. The book is thus suitable for use in technical colleges, and provides a fairly complete course in structural drawing office practice. With a few minor modifications, which the teacher can easily supply, the book can be brought into line with British practice and nomenclature, and ought to be of service to students of structural steel work in this country.

Calculus Made Easy. By F. R. S. Second Edition. Pp. x + 265. (London: Macmillan and Co., Ltd., 1914.) Price 2*s.* net.

THE author of this book has added many worked examples and exercises to those in his first edition; otherwise the book is but little altered and we have not much to add to the remarks we made five years ago. The motto is, "What one fool can do, another can." Perhaps there may still be too many encouraging remarks of a jokesome nature and too many expressions of disdain for the stupidity of the usual methods of teaching, but the title of the book is justified. The author does show that the most fundamental operations of the calculus are easy to understand and may be performed by beginners with success, that is, without vague notions of being wrong. J. P.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Surface Tension and Ferment Action.

MESSRS. BEARD AND CRAMER, in a paper under the above title published in the Proceedings of the Royal Society issued on June 1, describe experiments made with invertase with the object of determining "whether the action of a ferment on a substrate is affected by surface tension." They answer this question in the affirmative and draw far-reaching conclusions.

The method they use, however, is open to very serious criticism; we think that there is little doubt that the phenomena they describe are due entirely to the effect of alkali and not to change of surface tension. They have compared the activity of invertase towards cane-sugar in tubes filled either with glass wool or with capillary glass tubes or with glass beads with that of a control in an ordinary test-tube. Retardation of action was observed in all such cases.

All who have experience in working with saccharoclastic enzymes are well aware how extraordinarily sensitive these are to the influence of the minutest trace of alkali. This applies to the enzyme invertase in particular. In a paper published in the Proceedings of the Royal Society so far back as 1907 (Series "B," p. 362) we pointed out that unless hard glass vessels were used, it was impossible to obtain consistent results; in fact, it is not only necessary to carry out the action in hard glass vessels but it is essential also to use storage bottles and measuring pipettes of similar hard glass: even then the results are apt to be irregular.

The work done by Sörensen in co-ordinating enzyme activity with the degree of alkalinity or acidity of the medium is too well known to need description; his experience with invertase shows clearly how much the activity of the enzyme is influenced by the minutest trace of alkali. We look in vain in Messrs. Beard and Cramer's paper for any reference to the possible influence of alkali derived from the soft glass they used as a cause of retardation; it would appear that they have entirely overlooked this factor. So long as no definite evidence is brought forward to show that the retardation change they observed is not due to the action of alkali, it is unnecessary to attribute it to the influence of surface tension.

E. F. ARMSTRONG.
H. E. ARMSTRONG.

Training for Scientific Research.

IN connection with our position in regard to chemical industry, the present seems to be a suitable time for a careful discussion of what is doubtless not a new suggestion. It is a sufficiently obvious fact that the German chemical trades—especially those that most require highly-trained chemists—prosper in very much greater measure than our own, and, by general consent, the reason for this appears to be that the Germans appreciate the value of research more than we do. How then is a better appreciation of research to be fostered in this country? Various proposals to this end are being made; closer relationship between technical and theoretical chemistry, whatever that may mean; the establishment of an industrial council; the founding of scholarships, etc., all, doubtless, good things in their way, things, however, which have been

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tried already to some extent, but unfortunately without sufficient success to justify an expectation of their being able completely to accomplish the desired change.

In considering this question we ought, it appears to me, to search for some distinct difference between our educational practice and that of Germany, some difference great enough to be likely to have an important effect. Such is indeed easy to find, for there exists a difference so great that it might quite readily lead to very important results, and one which, probably because of its obviousness, is generally ignored. This far-reaching difference is simply that in Germany research work is absolutely indispensable for the *ordinary* degree (by "ordinary" I mean that ordinarily taken by students), and it is at least a very reasonable contention that the moment research work becomes essential for our ordinary degree (B.Sc.), with, naturally, any necessary lengthening of the course, so soon shall we have taken the step which will, not to-morrow, but in ten or fifteen or twenty years' time, perhaps place us on something like an equality with Germany in respect to the point at issue.

Two most important results might be expected to follow the introduction of compulsory research into the B.Sc. degree: (1) There would be provided throughout the country a considerable body of young chemists with some experience, say one year, at least, of research work. There is such a thing as a general method in research, and after even only one year's training in it the young chemist would be able to attack, with very much greater confidence than at present, many of the problems which arise in industrial practice, for in research work, emphatically, it is the first step that counts for most, and this first step being a thing that can be taught, it is the duty of the universities to teach it. (2) Sons of manufacturers who go to the university and take a science degree would of necessity carry out some original investigation, and from this particular class—composed of men who, for the most part, are possessed of some means and leisure—there would be likely to emerge a number of really capable chemists, who might indulge in the higher degree of D.Sc., men likely to carry their chemistry intelligently into their businesses. But even in those least interested there would necessarily be acquired some idea of what research means, some notion of how it might be applied to their own particular requirements, and it is probable that in a comparatively short time, say twenty years, the lack of appreciation of research work which is now attributed to the manufacturer would have wholly or largely disappeared.

In fact, the introduction of research into the ordinary degree would be likely to act in several ways. First upon the student, secondly upon the manufacturer, and thirdly upon theoretical chemistry by the achievement of the excellent educational principle, that the science would be the richer in some fact or in some theory for every graduate who had devoted himself to it. Fourthly, it would react upon the teachers.

Although this is, essentially, an exceedingly simple reform, there would doubtless be great difficulties in carrying it out; it would probably be urged that M.Sc. degrees have been instituted with this especial object, but that would be to misunderstand the present suggestion, the essence of which is that there shall be no degree at all, or anything resembling a degree, which does not require research work. At the present time, however, when traditional prejudices of all sorts are going by the board, it would probably be easy for the teachers to bring sufficient pressure to bear upon Parliament, or conversely, for Parliament or a resolute Government to bring sufficient pressure to bear on the teachers, to secure the immediate accomplishment of this desirable improvement.

It must, however, be sorrowfully admitted that such a change is not likely to make any particular financial difference to the young chemist, but in all probability it would give him a better opportunity for advancement once he had established himself in a technical post, and there is little doubt that the advantage to the country would be very great.

T. S. PATTERSON.

University of Glasgow (Organic Chemistry
Department), June 8.

Galileo and the Principle of Similitude.

WHEN I said in NATURE (April 22) that Herbert Spencer was the first to apply the principle of similitude to dynamical problems in biology, I spoke in haste. I might have remembered that Borelli had shown, by help of this principle, that a man would never be able to fly by his own muscular power, and why (for instance) small animals are more active and leap higher than big ones. But I was quite ignorant of the fact that Galileo had treated the whole subject on the broadest lines and with the utmost clearness. His discussion will be found in the "Dialogues concerning Two New Sciences," admirably translated by Prof. Henry Crew and Alfonso de Salvio (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1914). So numerous and interesting are the subjects dealt with in this wonderful book that the writer of a long and laudatory notice in NATURE (December 24, 1914) had not time or space to mention that the principle of similitude and the subject of animal mechanics are alluded to therein. The following extract (*op. cit.*, p. 130) is but a small part of what Galileo has to say upon the principle of similitude:—

"*Salviati*: 'From what has already been demonstrated, you can plainly see the impossibility of increasing the size of structures to vast dimensions either in art or in nature; likewise, the impossibility of building ships, palaces, or temples of enormous size in such a way that their oars, yards, beams, iron-bolts, and, in short, all their other parts will hold together; nor can nature produce trees of extraordinary size, because the branches would break down under their own weight; so also it would be impossible to build up the bony structures of men, horses, or other animals so as to hold together and perform their normal functions if these animals were to be increased enormously in height, for this increase in height can be accomplished only by employing a material which is harder and stronger than usual, or by enlarging the size of the bones, thus changing their shape until the form and appearance of the animals suggest a monstrosity. To illustrate briefly, I have sketched a bone the natural length of which has been increased three times and the thickness of which has been multiplied until, for a correspondingly large animal, it would perform the same function which the small bone performs for its small animal. From the figures here shown you can see how out of proportion the enlarged bone appears. Clearly, then, if one wishes to maintain in a great giant the same proportion of limb as that found in an ordinary man, he must either find a harder and stronger material for making the bones, or he must admit a diminution of strength in comparison with men of medium stature; for if his height be increased inordinately, he will fall and be crushed under his own weight. Whereas, if the size of a body be diminished, the strength of that body is not diminished in the same proportion; indeed, the smaller the body the greater its relative strength.

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